Pacific Science (1994), vol. 48, no. 4: 464–474

Contribution to the Marine Algal Flora of San Félix Island, Desventuradas Archipelago, Chile[1]

I. Meneses and A. J. Hoffmann[2]

ABSTRACT: Only 12 species of marine algae were known until now from the Desventuradas Archipelago. A recent collection added 10 species yielding a total of six Chlorophyta, nine Phaeophyta, and seven Rhodophyta. Only one species, *Padina tristromatica* Levring, is endemic. More than half of the representatives are in common with the flora of the Juan Fernández Archipelago, but only five species are also found on the continental coasts of Chile and Perú.

The San Félix and San Ambrosio islands and adjacent islets forming the Desventuradas Archipelago (26° 20′ S, 80° 00′ W approximately) are the least known among the Chilean oceanic territories. They rarely have been visited by biologists, and only twice by phycologists. Five species were described by Levring (1942), from material sent to him by C. Skottsberg. The second report of algal species in these islands was made by Etcheverry (1960), who added seven species to those previously reported.

In this paper we present descriptions of the taxa collected by one of the authors (A.J.H.) on a recent expedition and of additional material not previously examined from other collections. With this information at hand, it is possible to compare the algal flora from the Desventuradas Archipelago with that of the nearest geographical areas.

Study Area

San Félix (26° 17′ S, 80° 07′ W) and San Ambrosio (26° 20′ S, 80° 58′ W) are fragments of two islands of volcanic origin that belong, together with Easter Island and the Juan Fernández Archipelago, to a submarine range extending in an east-west direction. These islands are 972 km from the Chilean coast.

San Félix is small (2.5 km^2), triangular, and represents the northeastern half of the original volcano. Most of the island is formed by low slopes that increase to the west, reaching about 80 m in altitude. The maximum elevation is Cerro Amarillo (193 m) at the northernmost end of the island. González Isle (166 m^2) is separated from San Félix by a fracture formed by the collapse of the main crater (González-Ferrán 1987). The coastline is characterized by cliffs and the absence of sheltered bays. Only two small, sandy beaches appear periodically near the northern border of this extremely exposed island.

Climatic conditions (data from 10 yr of observations provided by the Armada de Chile) are humid, warm, Mediterranean type. The Emberger Index (di Castri and Hajek 1976) is 237 (humid), and the lowest temperature of the coldest month is 11.5°C. Thermal oscillations (differences between the average temperatures of February and August) are ca. 5°, suggesting an oceanic character. The seasonal rain pattern, with 54% of rainfall occurring in the austral winter, 24% in fall, 13% in spring, and 9% in summer, corroborates the Mediterranean character of the climate (Hajek and Espinoza 1987).

MATERIALS AND METHODS

Algal drift material was collected at the only beach existing at the time of the visit to San Félix. Algal specimens were preserved

[1] Manuscript accepted 30 December 1993.
[2] Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago, Chile.

TABLE 1

SPECIES RECORDED FROM THE DESVENTURADAS AND THEIR DISTRIBUTION IN OTHER RELATED REGIONS

SPECIES	DESVENTURADAS[a]	JUAN FERNÁNDEZ[b]	EASTER ISLAND[c]	CONTINENTAL CHILE AND PERÚ[d]
Chlorophyta				
Chaetomorpha firma Levring	+	+	—	+
Chaetomorpha antennina (Bory) Kuetzing	+	+	+	+
Cladophora sp.	+	?	—	?
Ulva rigida C. Agardh	+	+	—	+
Codiolum kuckuckii Skottsberg & Levring	+	+	—	—
Codium unilaterale f. *skottsbergianum* Setchell	+	+	—	—
Phaeophyta				
Myrionema strangulans Greville	+	+	—	+
Dictyota phlyctaenodes Montagne	+	+	—	—
Padina tristromatica Levring	+	—	—	—
Padina fernandeziana Skottsberg & Levring	+	+	—	—
Glossophora kunthii (C. Agardh) J. Agardh	+	+	—	—
Splachnidium rugosum (L.) Greville	+	+	—	—
Hydroclathrus clathratus (C. Agardh) Howe	+	+	—	—
Eisenia cokerii Howe	+	—	—	+
Sargassum sp.	+	—	—	—
Rhodophyta				
Liagora brachyclada Decaisne	+	+	—	—
Haliptilon roseum (Lamarck) Garbary & Johansen	+	+	—	—
Jania sp.	+	—	—	—
Polysiphonia sp. 1	+	?	?	?
Polysiphonia sp. 2	+	?	?	?
Ceramium flaccidum (Kuetzing) Ardissone	+	—	?	—
Dasya sp.	+	—	—	—

[a] Levring (1942), Etcheverry (1960), and this study.
[b] Setchell (1937), Levring (1941), Etcheverry (1960), Santelices and Abbott (1987).
[c] Santelices and Abbott (1987).
[d] Ramírez and Santelices (1991).

dry and transported to the laboratory in Santiago, where they were deposited at the University Herbarium collection (Sala de Sistemática [SSUC], Departamento de Ecología, Pontificia Universidad Católica de Chile). Material previously collected by L. Di Salvo and M. Edding at San Félix in 1983 and 1986, respectively, preserved in 5% formalin, was also included in this report. Hand and frozen sections were stained with aniline blue and mounted as permanent slides with 50% corn syrup (Karo, CPC International, Englewood Cliffs, New Jersey) in seawater.

RESULTS

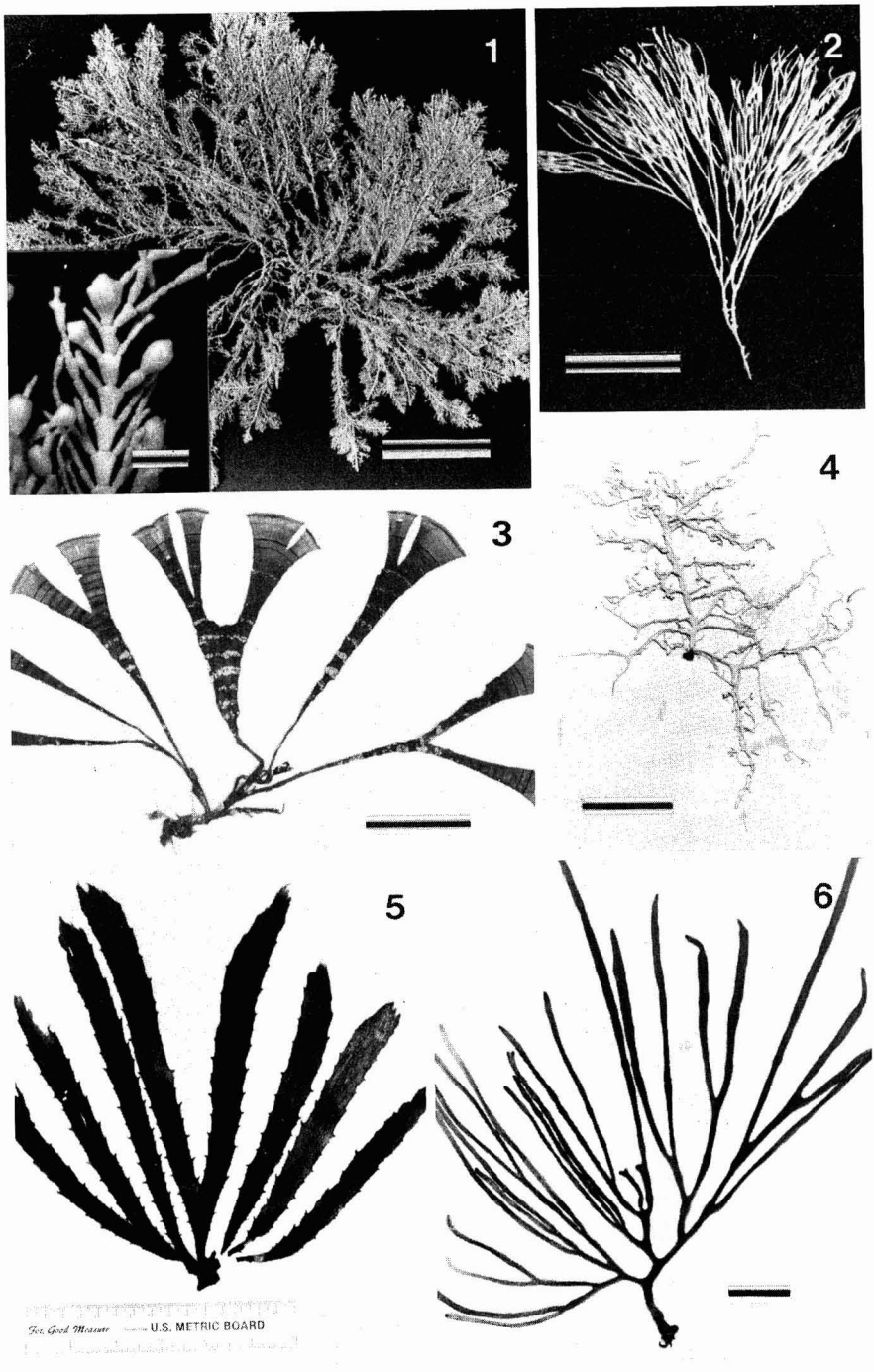
The algal species reported from San Félix Island by Levring (1942), Etcheverry (1960), and in this paper are listed in Table 1. A short description is given for each taxon followed by discussion and comparison with other related taxa when relevant. Specimens kept at the Sala de Sistemática of the Pontificia Universidad Católica de Chile at Santiago are noted as SSUC.

Haliptilon roseum (Lamarck) Garbary & Johansen, 1982

Figure 1

SSUC 6676, 6684 (4 sheets)

Plants 4.5 to 6.0 cm long (Figure 1). Main axis indeterminate, axial intergenicula from the middle and upper parts of the main axis 375–525 μm long and 300–500 μm broad, with pinnately arranged determinate branchlets one to several genicula long, intergenicula 250–575 μm long and 75–125 μm



FIGURES 1–6. (1) Thallus external morphology of *Haliptilon roseum* (scale = 2.5 cm). Insert shows close-up of cystocarpic conceptacles (scale = 1 mm). (2) Specimen of *Jania* sp. (scale = 5 mm). (3) Specimen of *Padina tristromatica*. Dark-haired zones can be observed (scale = 2.5 cm). (4) Specimen of *Liagora brachyclada* (scale = 2 cm). (5) Specimen of *Eisenia cokerii* without stipe and holdfast. Fronds are serrate and show longitudinal grooves (scale = 5 cm). (6) Specimen of *Codium unilaterale* f. *skottsbergianum* with typical branching pattern (scale = 3 cm).

broad. Determinate branchlets are unbranched or di- or trichotomously branched, ending in *Jania*-like tips or in conceptacles. Adventitious indeterminate branchlets are frequent at various distances below the apex; their branching pattern is similar to that of the main axis. In some of the specimens the adventitious branchlets arise secondarily on sides of the intergenicula opposite the lateral determinate branchlets. Determinate branchlets are often absent from the lower portions of the frond. This basal portion is characterized by long, narrow, naked intergenicula forming abundant stolons.

All fertile plants had tetrasporangial conceptacles. Conceptacles are axial in determinate or adventitious branchlets of one or several intergenicula. These are easily detected externally because of the noticeable swelling of the intergenicula (Figure 1, insert). Conceptacles are rounded, 300–350 μm in diameter, 400–510 μm in length (from the bottom of the chamber to the opening of the pore), with no distinctive channel to the opening. Sporangia are not well developed; fewer than 20 are formed per conceptacle.

Haliptilon roseum is common in southern Australia (Johansen and Womersley 1986). This is the first record from the South American coast (Isla San Félix), with the exception of a record of *Corallina cuvieri* Lamouroux collected in Juan Fernández Archipelago (Levring 1943), which should be reexamined to verify its status.

Jania sp.

Figure 2

SSUC 6679 (2 sheets)

Plants 1.5 to 2 cm high, pale pink with regular dichotomous branching of very fine, planar axes. Central segment of dichotomies resembles an inverted triangle with branches arising from each of the two angles at the base. No reproductive material collected.

Padina tristromatica Levring, 1942

Figures 3, 7

SSUC 6675 (5 sheets)

Thalli up to 12 cm were collected. Fronds are coriaceous, typically fan-shaped, although narrower (1.2–3.2 cm wide in the upper part) and less flabellate than in most species and irregularly branched by partial or total splitting of the frond (Figure 3). Fronds are marked by clear bands 2 mm wide and narrower dark bands, the latter with filaments. Dark bands of filaments are located alternately on either side of the frond. Fronds are light brown in the upper portion and dark, sometimes reddish brown, in the lower portion. The attachment portion is rich in rhizoids. No reproductive specimens were found.

A cross section through the frond shows the three layers of cells characteristic of this species (Figure 7). Occasionally, four layers are present in cross section with no apparent pattern of location within the frond. Clear and dark zones display the same cell arrangement, consisting of a first layer of slightly vertically elongated cells 29.3–41 μm high, a central layer of almost cubic cells 17.8–31.0 μm high, and a third layer of vertically elongated cells 44.5–57.6 μm high. All three layers of cells show the same width, 14.4–23.4 μm. Dark zones are rich in hairs consisting of uniseriate piles of flat cells that stained dark blue with aniline blue. These hairs appear to be present on only one surface of the frond at each band.

This is the second record for *Padina tristromatica* from San Félix Island. The species was also recorded from San Ambrosio (Levring 1942) and is apparently endemic to the Desventuradas Archipelago because no specimens have been collected from the adjacent continental coasts.

Padina tristromatica was described by Levring (1942) from material collected independently from San Félix and San Ambrosio islands. Characteristics of the species pointed out by Levring were the three layers of cells in the frond as well as the formation of double zones of sporangial sori separated by a band of hairs located on the opposite side of the frond. Although specimens in this study were not fertile, they all show the three-layered structure of the blade. Levring's description included measurements of thallus thickness between 100 and 130 μm, comparable with the range of 92–130 μm in our material.

No other members of the genus are reported from the continental coasts at the same latitude, but farther north in Perú *P.*

durvillaei Bory and another species of *Padina* have been recorded (Dawson et al. 1964, Acleto 1973). In addition to being strongly flabellate, both species in cross sections of the frond show a larger number of cell layers than those of *P. tristromatica.*

Liagora brachyclada Decaisne, 1842

Figure 4

SSUC 6682, 6683 (2 sheets)

Specimens collected are 5–8 cm long, rather irregularly alternate or pinnate. Medulla formed of long colorless filaments radially producing dichotomously branched assimilators. The latter are formed by elongated cells 12.5–20 μm long and 5–7.5 μm diameter. A carpogonial branch originates laterally at the base of the assimilators, slightly curved and four-celled. No other reproductive structures were observed.

Although the specimens internally are very similar to the detailed description and figures of *Liagora brachyclada* of Levring (1941:633–634, fig. 11), there are some differences in external morphology (*Liagora brachyclada* is described as being clearly dichotomous).

Eisenia cokerii Howe, 1914

Figures 5, 9, 10

SSUC 6676 (5 sheets)

Only blade material was found (Figure 5). Drift specimens often included 6–7 laminae growing from a thick, flattened base. Blade linear lanceolate, 20–30 cm long, 1.3–2.1 cm wide, with noticeable grooves extending longitudinally, margins coarsely serrate, the apex absent, probably eroded away by strong wave action.

Transverse and longitudinal sections of the blade (Figure 9) show a single layer of small pigmented cells 5–7.5 μm high and 3.8–10 μm wide and several layers of cortical parenchyma separated from a well-developed medulla by a zone with abundant sieve elements. These are characteristic of Laminariales: trumpetlike hyphae with enlarged cross walls with sieve areas. In longitudinal section sieve elements (Figure 10) are observed transversely as well as longitudinally placed around the medullary cells.

The *Eisenia* specimens from San Félix show a close resemblance to *Eisenia gracilis* Dawson in their blade morphology. However, *E. gracilis* lacks the pronounced longitudinal grooves characteristic of *E. cokerii.* These grooves are present in blades of all sizes, suggesting that this is not a character related to the age or growth stage of the blade. No muciferous canals have been observed in *E. cokerii* from Perú (Howe 1914); neither are they present in plants from San Félix. Dawson et al. (1964) mentioned the similarities between the Peruvian plants and *E. arborea* from California, similarities that are also observed in *Eisenia* plants from San Félix.

Eisenia cokerii has been recorded for the Peruvian coasts (Dawson et al. 1964), but this is the first record for areas southwest of Perú.

Codium unilaterale forma *skottsbergianum* Setchell, 1937

Figure 6

SSUC 6707 (1 sheet)

The unique specimen found in this collection reaches 27 cm in length and has cylindrical branches of 2 mm diameter at the base enlarging up to 5 mm toward the apex. The branching pattern is dichotomous to subdistichous, as described by Setchell & Gardner (1924) for the species, with unequal growth of one of the primary branches.

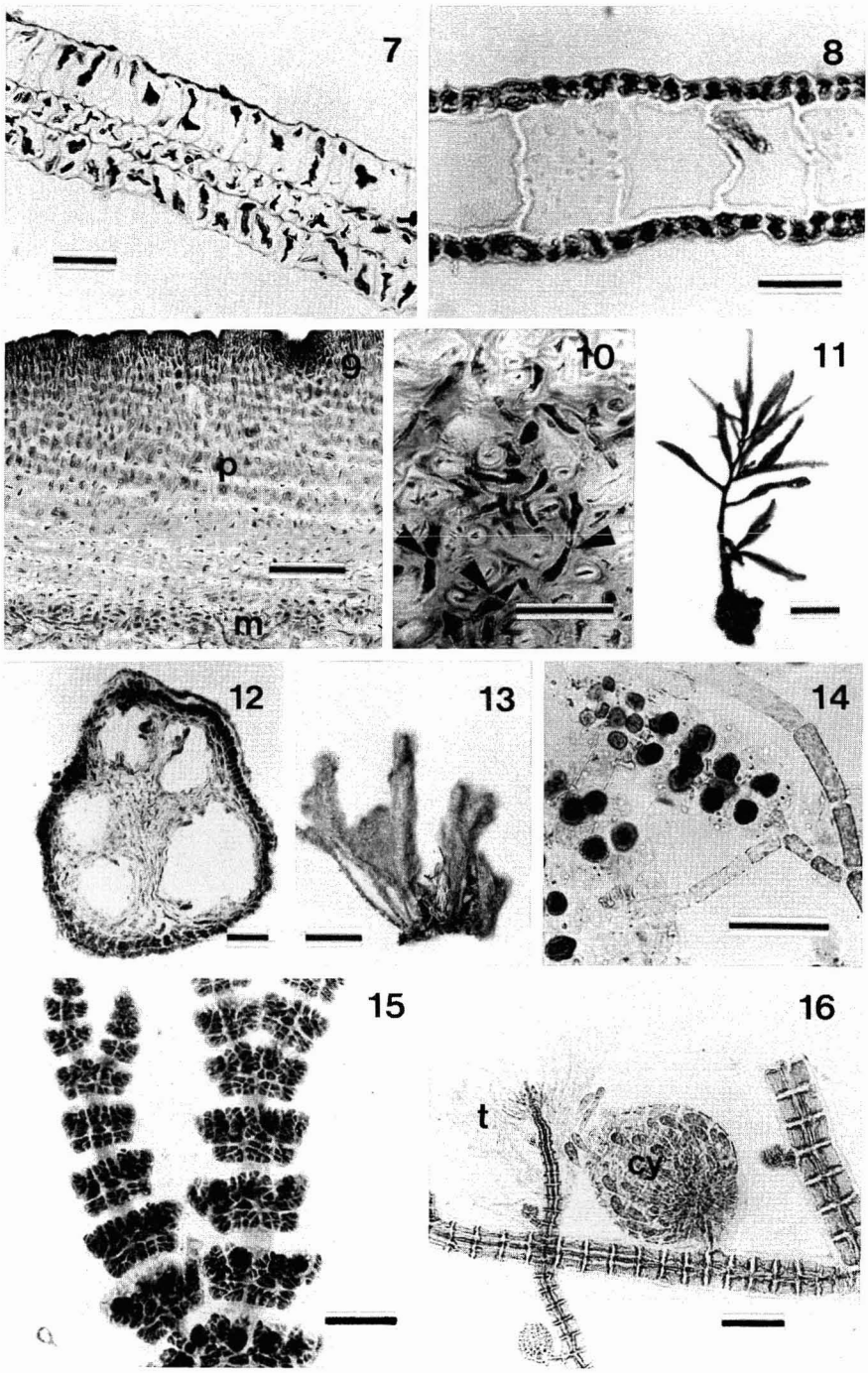
Utricles are cylindrical to clavate, up to 1.25 mm long, with their outer end slightly conical to smoothly rounded. Hairs commonly arise from the upper half of the utricles growing beyond them. Gametangia were not observed.

Dictyota phlyctaenodes Montagne, 1852

Figure 8

SSUC 6677

The few specimens of *D. phlyctaenodes* available from the San Félix collection reached 1.6 cm high. The small plants have an irregular dichotomous branching pattern, although in some the pattern is not clear. Fronds are 0.5–0.8 cm wide, with smooth margins and obtuse apices. Internally, two layers of small pigmented cells 20–27.5 μm high and 12.5–27.5 μm in diameter surround a central layer of large cells 62.2–105.6 μm high and 48–81.6 μm wide, with thick cell walls often perforated by pores (Figure 8).



FIGURES 7–16. (7) Cross section through the blade of *Padina tristromatica* showing the characteristic three-layered structure (scale = 60 μm). (8) Cross section through *Dictyota phlyctaenodes* (scale = 50 μm). (9) Longitudinal section of *E. cokerii* blade showing well-defined parenchymatic (p) and medullary (m) zones (scale = 200 μm). (10) Enlarged section of medullary zone in *E. cokerii*. Trumpetlike hyphae (arrowhead) are common throughout (scale = 50 μm). (11) Small specimen of *Sargassum* sp. (scale = 5 mm). (12) Cross section through *Sargassum* sp. thallus showing conceptacle cavities (scale = 50 μm). (13) External morphology of *Dasya* sp. (scale = 0.5 cm). (14) *Dasya* sp. stichidia with tetrasporangia (scale = 50 μm). (15) Tetrasporangial branch of *Ceramium flaccidum* (scale = 50 μm). (16) *Polysiphonia* sp. 1 displaying cystocarps and trichoblasts (scale = 50 μm).

Rhizoids develop at the base of the plant as well as along the lower portions of the fronds. Lower portions of the fronds show occasional proliferations having the same shape as the dichotomous fronds although narrower. One of the specimens displays a sorus with several developmental stages of oogonia.

Although *Dictyota* is a widespread genus in temperate and tropical waters, few records of the genus have been made in nearby waters, with the exception of *D. dichotoma* (Huds.) Lamour. in Tumbes, Perú (Dawson et al. 1964) and in Antofagasta and Cobija, Chile (Ramírez and Santelices 1981) and of *D. phlyctaenodes* recorded in the Juan Fernández Archipelago (Levring 1941). This last species had been recorded previously for San Ambrosio by Etcheverry (1960).

Sargassum sp.

Figures 11, 12

SSUC 6685 (3 sheets)

A set of small plants, 2.3–4.0 cm tall, and several fragments are part of the collection of this genus from Isla San Félix and Isla Sala-y-Gómez (Figure 11). Fronds are 0.5–3.0 cm long, 0.5–2.0 mm wide, lanceolate, margins serrate, placed alternately in the main axis, no secondary axes observed. Only one receptacle was found; conceptacles were empty (Figure 12), poorly preserved, 10–20 by 9–15 μm in diameter.

Polysiphonia sp. 1

Figure 16

SSUC 6695 (slide)

This genus is represented by two species in the San Félix material. The first was found forming small turfs along with *Jania*, *Cladophora*, and *Ceramium*. It is a delicate plant, less than 1 cm high, with a short prostrate axis giving rise to well-developed upright branches. Erect axes with lateral irregular branching frequently are interspersed with unilateral branches. There are four pericentral cells 2 to 2.6 times longer than wide, 80–90 μm long, and 32–40 μm wide. Trichoblasts are present, abundant, with dichotomous branching, sometimes trichotomous to alternate, pigmented, cells 25–44 μm long, (3)5–6.3(8) μm wide. Trichoblast and scar cell position are in a 1/4 spiral sequence clockwise. Only cystocarpic plants were observed (Figure 16); cystocarps follow trichoblast sequential arrangement.

Polysiphonia sp. 2

SSUC 6696 (1 sheet and slides)

The second species of this genus, abundant among the samples, consists of plants that form short, shrubby assemblages with other species such as *Jania*. Prostrate axes are less developed than upright ones, the latter 1 to 2 cm high. Upright axes with irregular branching that can range from unilateral to alternate, in general highly variable. There are four pericentral cells 1 to 2 times wider than long, 120–200 μm long, 240–300 μm wide in main axes. Mature tetrasporangial plants are without trichoblasts, or if present, these are poorly developed, sometimes with a single dichotomy, 6 to 8 small pigmented cells. Tetrasporangia are located in the apical portion of the lateral branches, irregularly rounded, 50–80 μm in diameter. Only cystocarpic specimens were found among gametophytes. Trichoblasts are abundant and strongly developed on these plants, only basal cells pigmented, 5–10 μm wide, 35–85 μm long. Cystocarps are globose.

Although this species somewhat resembles the figure of *Polysiphonia succulenta* Harvey published by Womersley (1979:521, fig. 7c and 7d), the San Félix material differs in having pericentral cells broader than long, whereas *P. succulenta* has pericentral cells twice as long as broad. Also, trichoblasts or scar cells do not appear in each segment of *Polysiphonia* sp. 2 as they do in the Australian species; rather, they appear only in cystocarpic plants. Finally, the slight cortical development near the base that Womersley mentioned was not observed in *Polysiphonia* sp. 2.

Ceramium flaccidum (Kuetzing) Ardissone, 1871

Figure 15

SSUC 6697 (1 slide)

These are small plants, 3 to 9 mm tall, entangled with *Jania*, *Polysiphonia*, and *Cla-*

dophora, epiphytic on some of these genera or saxicolous. The thallus has a short prostrate portion and a well-developed upright portion. The branching pattern varies from dichotomous to alternate; swollen nodes in the upper half of the plant give a stout appearance. Attachment through long unicellular rhizoids originates from the lowest parts of the upright axes and from the prostrate portion of the thallus; these can end in either blunt apices or digitate discoid bases. Apices are straight or forcipate. Cortication is restricted to nodes; basal internodes are 1.3 to 2.3 times as long as broad, becoming shorter toward the upper portion of the thallus until they are barely visible at the apex, 220–350 μm long, 130–160 μm in diameter. Basalmost nodes are 80–90 μm long and 130–150 μm in diameter, becoming swollen toward the apex and in the presence of tetrasporangia.

Nodes consist of 5–6(7) pericentral cells irregularly shaped with rounded margins, slightly taller than broad, 22.5–30.0 μm by 20.0–30.0 μm in vertical and horizontal axes, respectively. Cortication originates from the basipetal formation of cells initially horizontally elongated. These divide soon into cells of similar size with angular margins, 10–15 by 7.5–12.5 μm in diameter. Acropetally, pericentrals form smaller cells with irregular shape, 12.5–17.5 μm proximally and (2.5)5–10 μm distally in diameter. An annular space frequently is observed approximately at the middle of the node, dividing it clearly into a basipetal and acropetal portion.

Tetrasporangia are present at the uppermost branches (Figure 15), 5 to 6 or 7 per node, ca. 30 μm in diameter, rounded, embedded in the cortical cells, which resemble an involucrum. Spermatangia are superficial, covering most of the cortication of upper nodes. Cystocarps are subterminal, subtended by 5 to 6 lateral adventitious branches.

An extensive review of the Australian representatives of this genus by Womersley (1978) included under *Ceramium flaccidum* several other species such as *C. transversale* Collins & Harvey, *C. dawsonii* Joly, *C. masonii* Dawson, *C. gracillimum* var. *byssoideum* (Harvey) Mazoyer, *C. fimbriatum* Setchell & Gardner, *C. byssoideum* Harvey, and *C. taylorii* Dawson. The San Félix material shows characteristics that fit the description of Dawson (1950) and the type specimen of *C. taylorii*. According to the synonymy of Womersley (1978), this species has a cosmopolitan distribution in tropical and temperate waters. A specimen of *Ceramium cruciatum* Collins & Harvey from Easter Island (Etcheverry 1960) also has the clear space in the lower half of the node typical of *C. flaccidum*. This could mean that Etcheverry (1960) mistook these two species. Unfortunately, no specimens of *C. flaccidum* have been collected in later studies (Santelices and Abbott 1987).

Dasya sp.

Figures 13, 14

SSUC 6703, 6704 (2 sheets and slides)

Plants collected were 3 to 5 cm long, with several upright branches arising from a rhizomelike axis (Figure 14). Each upright branch consists of a thick main axis that shows no further lateral branching. The main axes consist of 5 pericentral cells densely corticated by several layers of rhizoidal cells 10–25 μm wide and 18–50 μm long. Monosiphonous filaments are present only on the upper half of the axes, arranged spirally around them; several originate from 2 to 3 basal cells, forming a bouquetlike structure. They are dichotomously branched 1 to 2 times only at their basalmost portion and are slightly blunted at the tip of each filament. Cells are 30–40 μm wide and 160–230 μm long.

Only sporangial material was available. Sporangia are in terminal stichidia (Figure 14) located at the base of monosiphonous filaments or at the base of the first dichotomy of these; they are rarely intercalar. There are four sporangia per stichidium segment, 25–30 μm in diameter.

No representatives of this genus have been recorded previously from the Desventuradas or the Juan Fernández Islands. But *Dasya villosa* Harvey and *Dasya* sp. are reported from Easter Island (Santelices and Abbott 1987).

DISCUSSION

The results add 10 new records to the marine algal flora of the Desventuradas Archipelago, allowing a partial comparison with the flora of nearby continental areas and other oceanic islands. In the following analysis we include the material reported by Levring (1942), Etcheverry (1960), and those taxa identified during the course of this study.

Padina tristromatica Levring is the only endemic species among the 14 taxa identified. This may be modified after further studies on the flora of these Islands. However, if this is a reflection of the actual endemism in the islands it indicates that their degree of isolation is considerably less in comparison with Easter Island and the Juan Fernández Archipelago, which show 13 and 29% endemic species, respectively (Santelices 1987, 1992).

To understand the geographic affinities of the species in the Desventuradas, we will compare them with those of the Juan Fernández Archipelago, because of its proximity and the information available on its macroalgal flora.

The Desventuradas show oceanographic characteristics different from those of the Juan Fernández Islands. The Desventuradas are located in a transition zone between subtropical and subantarctic waters. The influence of the latter is especially evident during winter; most of the year the Islands are exposed to a superficial oceanic regime of subtropical waters (Bahamonde 1987). The opposite situation is the case in the Juan Fernández Islands, where superficial subantarctic waters reach the coast during the entire year except in summer, when they are replaced by superficial subtropical waters. This oceanographic regime could explain the importance of subtropical genera in San Félix, represented by *Sargassum*, *Jania*, and *Dasya* among others.

Located at roughly a similar distance from the coast of continental Chile as the Juan Fernández Archipelago, the Desventuradas are much smaller in area (10.3 km^2) than the Juan Fernández Islands (whose biggest island, Robinson Crusoe, is 93 km^2 in area). The small size and probably the reduced heterogeneity of habitats (mainly cliffs, lack of beaches or intertidal with smooth slopes) account for the low number of algal species. The situation is also similar for terrestrial plants, with 21 species in the Desventuradas versus 327 species in the Juan Fernández Islands (Hoffmann and Marticorena 1987). However, the low number of species reported for algal taxa could be a result of the few studies done on this group.

The presence of 12 species shared by the two archipelagos, three of which are exclusive to them, indicates the movement of species from one to another either in the form of propagules carried by the Chile-Perú Current or through human intervention in the form of lobster fishing boats that roam among these Islands (Bahamonde 1987).

Of relevance is the low number of species in common between the two archipelagos and the continental coast of South America (including Chile and Perú). This fact, added to the occurrence of a single species in common with Easter Island, shows the degree of isolation of the Desventuradas and the Juan Fernández Archipelago with respect to the continent.

Low affinities are detected between the algae of the Desventuradas and those of the nearby continental coasts of Perú and Chile. Only *Eisenia cokerii* is present also in Tumbes, Perú. However, the actual distribution of *E. cokerii* is difficult to assess because the similarities of this taxon to *E. arborea* from California eventually could lead to the recognition of a single species with morphological variants along the temperate Pacific coast of the Americas (Dawson et al. 1964).

On the other hand, six of the species (40%) present in the Desventuradas also occur in the tropical and temperate zones of the South Pacific (South Africa, Australia, Tasmania, New Zealand). They are also part of the Juan Fernández flora. Santelices (1992) suggested for the latter archipelago the arrival of species from such distant places through the Chile-Perú Current, although emphasizing the current lack of knowledge of long-range dispersal in the seaweeds. However, the Juan

Fernández Archipelago could well be the previous step to the arrival of those species in the Desventuradas.

ACKNOWLEDGMENTS

We thank Isabella A. Abbott for kindly reviewing the first draft of the manuscript. The first author is grateful to M. Edding for allowing her to examine his collections from San Félix Island.

LITERATURE CITED

ACLETO, C. 1973. Las algas marinas del Perú. Bol. Soc. Peruana Bot. 6:1–164.

ARDISSONE, F. 1871. Rivista del Ceramii della flora Italiana. Nuovo G. Bot. Ital. 3:32–50.

BAHAMONDE, N. 1987. San Félix and San Ambrosio, the Desventuradas Islands. Pages 85–100 *in* J. C. Castilla, ed. Islas Oceánicas Chilenas: Conocimiento científico y necesidades de investigaciones. Ediciones Universidad Católica de Chile, Santiago.

DAWSON, E. Y. 1950. A review of *Ceramium* along the Pacific coast of North America with special reference to its Mexican representatives. Farlowia 4:113–138.

DAWSON, E. Y., C. ACLETO, and N. FOLDVIK. 1964. The seaweeds of Perú. Nova Hedwigia 13:1–111, 81 pl.

DECAISNE, J. 1842. Memoire sur les Corallines ou Polypìers calciferes. Ann. Sci. Nat. Bot. (series 2) 18:96–128.

DI CASTRI, F., and E. R. HAJEK. 1976. Bioclimatología de Chile. Vicerrectoria Academica, Universidad Católica de Chile, Santiago.

ETCHEVERRY, H. 1960. Algas marinas de las Islas Oceánicas Chilenas (Juan Fernández, San Félix, San Ambrosio y Pascua). Rev. Biol. Mar. 10:83–138.

GARBARY, D. J., and H. W. JOHANSEN. 1982. Scanning electron microscopy of *Corallina* and *Haliptilon* (Corallinaceae, Rhodophyta): Surface features and their taxonomic implications. J. Phycol. 18: 211–219.

GONZÁLEZ-FERRÁN, O. 1987. Geological evolution of Chilean Pacific Oceanic Islands. Pages 37–53 *in* J. C. Castilla, ed. Islas Oceánicas Chilenas: Conocimiento científico y necesidades de investigaciones. Ediciones Universidad Católica de Chile, Santiago.

HAJEK, E., and G. A. ESPINOZA. 1987. Meteorology, climatology and bioclimatology of the Chilean Oceanic Islands. Pages 55–83 *in* J. C. Castilla, ed. Islas Oceánicas Chilenas: Conocimiento científico y necesidades de investigaciones. Ediciones Universidad Católica de Chile, Santiago.

HOFFMANN, A. J., and C. MARTICORENA. 1987. The vegetation of Chilean Oceanic Islands. Pages 127–165 *in* J. C. Castilla, ed. Islas Oceánicas Chilenas: Conocimiento científico y necesidades de investigaciones. Ediciones Universidad Católica de Chile, Santiago.

HOWE, M. A. 1914. The marine algae of Perú. Mem. Torrey Bot. Club 15:1–185, 66 pl.

JOHANSEN, H. W., and H. B. S. WOMERSLEY. 1986. *Haliptilon roseum* (Corallinaceae, Rhodophyta) in southern Australia. Aust. J. Bot. 34:551–567.

LEVRING, T. 1941. Die Meeresalgen der Juan Fernández Inseln. Pages 601–670, pls. 49–53 *in* C. Skottsberg, ed. The natural history of Juan Fernandez and Easter Island, Vol. 2, Part 5, No. 22. Almqvist & Wiksells, Uppsala.

———. 1942. Einige Meeresalgen von den Inseln San Ambrosio und San Felix. Bot. Not. 1942:60–62.

———. 1943. Die Corallinaceen der Juan Fernandez Inseln. Pages 753–757 *in* C. Skottsberg, ed. The natural history of Juan Fernandez and Easter Island, Vol. 2, Part 5, No. 25. Almqvist and Wiksells, Uppsala.

MONTAGNE, C. 1852. Algas. Pages 228–393 *in* C. Gay, ed. Historia Física y Política de Chile. Botánica, Vol. 8. Paris.

RAMÍREZ, M. E., and B. SANTELICES. 1981. Análisis biogeográfico de la flora algológica de Antofagasta (norte de Chile). Bol. Mus. Nac. Hist. Nat. Chile 38:5–20.

———. 1991. Catálogo de las algas marinas bentónicas de la costa temperada del Pacífico de Sudamerica. Monografías Biológicas 5. Pontificia Universidad Católica de Chile, Santiago. 437 pp.

SANTELICES, B. 1987. Flora marina bentónica de las Islas Oceanicas Chilenas. Pages 101–126 *in* J. C. Castilla, ed. Islas Oceánicas Chilenas: Conocimiento científico y necesidades de investigaciones. Ediciones Universidad Católica de Chile, Santiago.

———. 1992. Marine phytogeography of the Juan Fernández Archipelago: A new assessment. Pac. Sci. 46:438–452.

SANTELICES, B., and I. A. ABBOTT. 1987. Geographic and marine isolation: An assessment of the marine algae of Easter Island. Pac. Sci. 41:1–20.

SETCHELL, W. A. 1937. The Codiums of the Juan Fernandez Islands. Pages 587–600, pls. 34–38 *in* C. Skottsberg, ed. The natural history of Juan Fernandez and Easter Island, Vol. 2, Part 5, No. 21. Almqvist and Wiksells, Uppsala.

SETCHELL, W. A., and N. L. GARDNER. 1924. New marine algae from the Gulf of California. Proc. Calif. Acad. Sci. 12:695–949, pl. 12–18.

WOMERSLEY, H. B. S. 1978. Southern Australian species of *Ceramium* Roth (Rhodophyta). Aust. J. Mar. Freshwater Res. 29:205–257.

———. 1979. Southern Australian species of *Polysiphonia* Greville (Rhodophyta). Aust. J. Bot. 27:459–528.